Fire-driven changes in subalpine forest landscapes reduce habitat for forest wildlife during the 21st century

Abstract

Background/Question/Methods

Climate change will profoundly influence wildlife populations by directly altering environmental conditions and through novel disturbance regimes that affect habitat quantity and quality. In the northern US Rocky Mountains, increased fire activity associated with climate warming could fundamentally change habitat availability for forest species adapted to historical fire regimes. We asked how alternative future scenarios of warming climate and increased fire in the Greater Yellowstone Ecosystem (Wyoming, USA) could affect habitat area for pine marten (PIMA, *Martes americana*) and Black-backed woodpecker (BBWO, *Picoides arcticus*) during the 21st century. BBWO is a burned-forest specialist, favoring severely burned stands of dense, large-diameter conifers, which provide abundant food and nesting resources. PIMA favors mature structurally complex conifer forests with large-diameter trees in structurally complex stands that support their prey and denning sites. We developed rule-based habitat suitability models and combined them with projected forest structures for two ~500 km^2 landscapes (northern Yellowstone National Park-Custer Gallatin National Forest; and northern Grand Teton National Park) simulated using the spatial, process-based forest model iLand. We estimated habitat area for both species through 2100 for several future climate scenarios.

Results/Conclusions

In future climate scenarios where warmer, drier conditions promoted more fire (e.g., HadGEM2-CC RCP 8.5), potential BBWO habitat increased with fire activity through the mid-21st century to a maximum of ~5% of the landscape, then declined to <1% as tree size, density and cover declined. Although BBWO use recently burned habitat, which is always ephemeral, the area suitable for BBWO by 2100 was lower than at the beginning of our simulations. Potential PIMA habitat declined steadily from 20-40% of the landscapes in 2020 to ~5% in 2090 as tree density, age and cover declined. However, when precipitation also increased with warming, tempering fire activity (e.g., CanESM RCP 4.5), BBWO and PIMA habitat both declined continuously, but PIMA habitat was higher in 2100 than in scenarios where fire activity increased. Spatial patterns of habitat availability reflected changes in forest structure. By 2100, habitat for both species was reduced to small refugia of mature forests where 21st-century fire activity was moderate. Effects of climate- and fire-driven changes in forest landscapes will affect wildlife species differently and may lead to surprising changes in 21st-century wildlife assemblages.

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